

Application No. 10/692,308
Amendment Dated January 10, 2006
Reply to Office Action Dated October 10, 2005

Remarks

Claims 1-13 are pending.

Claims 1-13 stand rejected.

Claims 1-13 are submitted herein for review.

No new matter has been added.

In the Office Action, the Examiner has objected to the specification and the figures, because it appears from the specification that a figure or figures is referenced, but no figure has been furnished. Applicant submits that this is a result of typographical error that occurred when converting the file from the priority document. A few of the original line numbers were inadvertently merged into the text, randomly placing several multiples of the #5 throughout the specification. Applicant has amended paragraphs [0007], [0009], [0011], [0022], [0024], [0029], [0038], [0054], [0058], [0059], [0063], [0077], [0084], [00 85], and [0088] accordingly and respectfully requests that these objections be withdrawn. Applicant notes that the original priority application and this application, which is a translation thereof, does not include, nor does it require, any figures.

The present invention as claimed in independent claim 1 is directed to a superconducting cable conductor containing a carrying element, onto which is wound at least one

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layer comprising two or more superconducting conductor elements. The individual superconducting conductor elements of each layer are arranged next to one another, and the superconducting conductor elements contain a tape-type substrate coated with a superconducting material based on rare earth barium cuprate. Independent claim 13 is a method claim directed to producing a similar superconducting cable.

The present invention related to a superconductor cable conductor composed of a carrying element or former on which at least two tape-type REBCO superconductors on a substrate, so called coated conductors, are helically wound to form a layer. In each layer, the tape conductors are arranged side by side.

The superconductor cable conductor may include two or more layers each composed of at least two tape-type superconductors helically wound onto the underlying layer. Thus, each layer comprises at least two tape-type superconductors helically wound onto the carrying element and the underlying layer.

In such an arrangement the conductors, comprising helically wound tape-type superconductors, the tape-type superconductor must withstand considerable bending stress caused by winding. It is important to note that REBCO superconductors are ceramic material which is brittle and liable to mechanical damage upon bending. Furthermore, the superconducting properties, such as critical density, of tape-type superconductors depend strongly on the orientation of the superconducting phase. With increased bending stress there is the risk that this orientation is affected or destroyed resulting in the reduction of superconducting

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properties. (See paragraphs [0008], [0010] and [0058] of the present invention)

These problems from bending are even more pronounced in cables with small diameters, where the tape-type superconductors are wound in small angles and lay lengths causing increased bending stress. Moreover, such cable conductors require that good superconductor properties are maintained over a long length extension.

The present invention has addressed this problem of bending stresses in a novel manner not disclosed in the prior art. Coated conductors with a REBCO layer applied onto a tape-type substrate can withstand high bending and tension stress without degradation and impairment of the orientation of the superconducting phase. Thus, according to the arrangement of the present invention, carrying elements of considerably smaller diameters can be used, resulting in thinner cables relative to conventional cables or multi-filament wires with higher superconducting cross sections with comparably similar superconducting properties (See paragraphs [0058] and [0059].

In the Examiner's first rejection, the Examiner claims that claims 1-2, 4-7, 9 and 13 are rejected under 35 U.S.C. § 102(e) as being anticipated by Norton et al. (U.S. Patent No. 6,849,580.

As illustrated in Fig. 3, the Norton reference teaches a superconductor cable having two layers of coated conductors, namely 346 and 352 (see column 8, lines 47-51). Contrary to the Examiner's statement in page 3 of the Office Action, the superconducting cable according to Figure 3 of Norton does not show one layer with two or more superconducting elements (346 or 352) but two distinct layers of coated conductor.

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As such, there is no teaching or suggestion in Norton that discloses the present invention as claimed. For example, there is no teaching or suggestion in Norton that discloses winding at least two tape-type coated conductors side by side onto the carrying element in one layer. Furthermore, there is no teaching or suggestion in Norton that discloses a tape-type conductor helically wound around the carrying element. As indicating above, there is no indication in Fig. 3 of Norton (or corresponding column 8) that the coated conductors are helically wound around the carrying element but instead it appears the coated conductor forms a sheathing. Therefore, Norton does not teach or suggest an arrangement that allows for smaller diameter cables to be obtained with tape-type REBCO coated conductors.

For at least these reasons, Applicant respectfully requests that the rejection of independent claims 1 and 13 in view of the Norton reference be withdrawn. As claims 2-12 depend from claim 1, the rejection of these claims should be withdrawn for the same reasons.

Turning to the next rejection, the Examiner rejects claims 1-4 and 6-13 under 35 U.S.C. § 103(a) as being unpatentable over Fujikami et al (EP 0650205 A1) in view of Beach et al. (U.S. Patent No. 6,440,211).

The present invention is discussed in detail above. On the other hand Fujikami discloses a generic superconductor cable where the layers are composed of multi-filamentary superconducting wires. The multi-filamentary superconducting wires are wound next to one another onto a carrying element. Such multi-filamentary superconducting wires are obtained by the so called power-in-tube method.

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However, depending on the diameter of the carrying element onto which the multi-filament wires are wound, and on the lay lengths of the individual turns, forces caused by bending, elongation or tension stress are exerted on the wires during the winding process and in the unwound state. This results in impairment of the superconducting phase and thus in a reduction of the superconducting properties. (See paragraph [0012] of the present invention)

The other reference cited by the Examiner, Beach, is directed to a method of depositing buffer layers on biaxially textured metal substrates in the preparation of coated conductors. In the discussion of the background of Beach a general reference is made that the obtained superconducting wires can be used for power transmission lines (See column 1, lines 32-33). However, there is no indication as the specific design of such a power transmission line, nor is there any further information how to obtain such a power transmission line. In particular, there is no indication as to the bending resistance and the suitability of the superconducting wire disclosed in Beach in cable conductors with particular bending stresses.

One of ordinary skill in the art faced with the problem of decreasing the diameter of superconductor cables and, thus looking for a material that can withstand high bending stresses has no motivation to replace the multifilament wires of Fujikami by the superconducting wires disclosed in Beach. This is particularly true, since in Beach there are no disclosures as to the superconducting properties over a long length of the wire as requires in cable applications.

As such, Applicant respectfully submits that the cited prior, namely Fujikami and Beach can not be combined as suggested by the Examiner. Furthermore, even if combined, the resulting structure would still not teach or suggest a superconducting *cable conductor*

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constructed by winding at least two tape-type coated conductors side by side onto the carrying element in one layer.

For at least these reasons, Applicant respectfully requests that the rejection of independent claims 1 and 13 in view of the Fujikami and Beach references be withdrawn. As claims 2-12 depend from claim 1 the rejection of these claims should be withdrawn for the same reasons.

Turning now to the final substantive rejection, the Examiner has rejected claims 1-13 under 35 U.S.C. § 103(a) as being unpatentable over Fujikami in view of Alford et al. (“High-temperature superconducting thick films”).

Applicants have previously discussed the present invention and the Fujikami reference. The Alford reference relates to high temperature superconductor thick films. In Alford the different properties of a plurality of suitable superconductors materials are discussed beside YBCO, such as BSCCO2212 and 2223 etc. (See table 1 for example)

Under section 3 of Alford, beginning on page 177, several applications of such thick films are discussed. Under section 3.5, the application YBCO in thick film conductors is discussed. According to this discussion superconductor films with sufficient superconducting properties are restricted to specimens of only about 40mm in length, insufficient length for cable conductors. Though it is stated at the end of the same column that despite the limitations this demonstration of feasibility should be extremely encouraging it must be born in mind that for cable conductor lengths of at least several meters are required. A confirmation of the limited suitability of YBCO thick films in wires is made under the conclusions headings on page 183,

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right column, which explicitly states that BSCCO was seen to be the material of preference for thick film wire or tape conductors. Moreover in Alford there is no indication as the bending resistance properties.

One of ordinary skill in the art seeking an alternative of the multi-filament wires disclosed in Fujikami, in particular seeking an improved bending resistance, has no motivation to apply a YBCO thick film as discussed in Alford in a long length cable conductor in view of the very small length over which good superconductor properties are achievable. Further, Alford gives no indication that such a YBCO wire can withstand the bending strength generated by winding in small diameter cables.

As such, Applicant respectfully submits that the cited prior, namely Fujikami and Alford can not be combined as suggested by the Examiner. Furthermore, even if combined, the resulting structure would still not teach or suggest a superconducting *cable conductor* constructed by winding at least two tape-type coated conductors side by side onto the carrying element in one layer.

For at least these reasons, Applicant respectfully requests that the rejection of independent claims 1 and 13 in view of the Fujikami and Alford references be withdrawn. As claims 2-12 depend from claim 1 the rejection of these claims should be withdrawn for the same reasons.

Applicant respectfully submits that pending claims 1-13 are in condition for allowance, the earliest possible notice of which is earnestly solicited. If the Examiner feels that an interview

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would facilitate the prosecution of this Application she is invited to contact the undersigned at the number listed below.

Respectfully submitted,

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